

SF₆ and Alternatives: State Regulatory Activities



National Electrical Manufacturers Association

Agenda



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California
Regulations

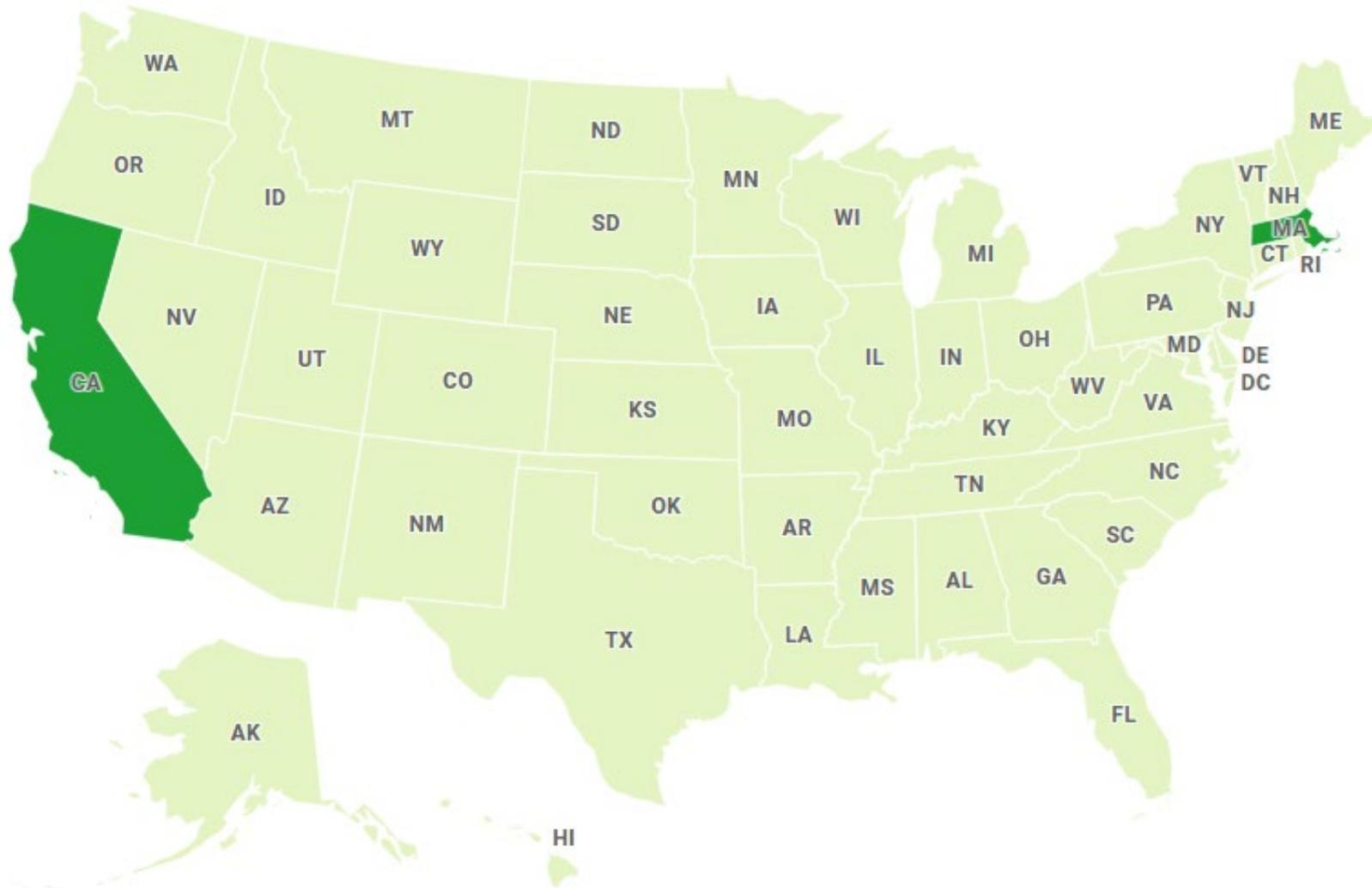
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Other
States

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Polyfluorinated Alkyl
Substances (PFAS)

States with SF₆-related Regulations



California Air Resources Board, CARB

- Legislative mandate in 2006 (AB 32) to reduce GHG emissions
- First regulation proposed in 2010 by CARB; took effect in January 2011.
- All owners of non-hermetically sealed SF6-insulated equipment must reduce annual emissions rate to 10%, with subsequently 1% annual reductions
- Updated in 2022

Revisions to Carb Regulation: Definitions

- Active GIE: ...non-hermetically sealed GIE that is connected through cables or busbars to the electrical power system, or that is fully charged, ready for service, and being prepared for connection...
- Covered Insulating Gas: ... an insulating gas with a GWP > 1
- Many others...

Revisions to CARB Regulation:

SF6 Phase-out Dates for SF6 GIE with Voltage Capacity $\leq 38\text{kV}$

§ 95352

Configuration	Voltage Capacity	Short-Circuit Current	Phase-out Date
Above Ground	< 38	All	January 1, 2025
	38	All	January 1, 2028
Below Ground	≤ 38	<25	January 1, 2025
		≥ 25	January 1, 2031

Revisions to CARB Regulation:

SF6 Phase-out Dates for SF6 GIE with Voltage Capacity > 38kV

§ 95352

Voltage Capacity	Short-Circuit Current	Phase-out Date
38 < kV < 145	<63	January 1, 2025
	≥63	January 1, 2028
145 < kV ≤ 245	<63	January 1, 2027
	≥63	January 1, 2031
> 245	All	January 1, 2033

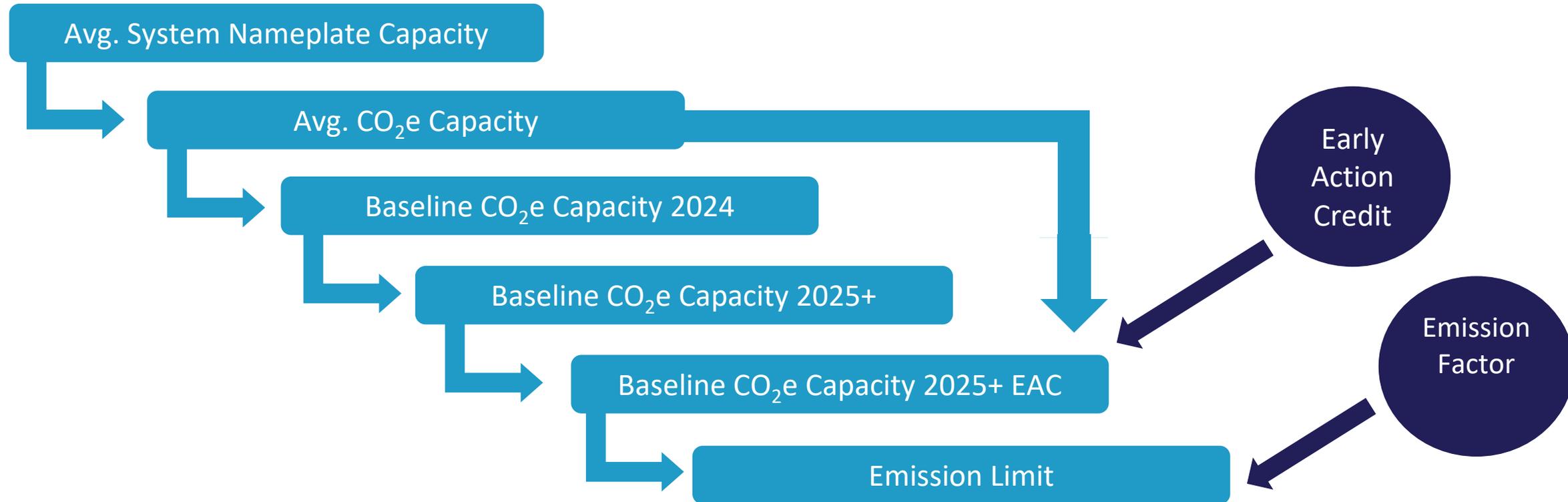
Revisions to CARB Regulation:

§ 95352a Special Conditions

- Equipment failure
- Equipment purchase prior to phase-out date
- GIE replacement under terms of warranty
- Replacement parts
- Exemption: limited availability

Revisions to CARB Regulation

§ 95353 Annual Emissions Limit



Revisions to CARB Regulation

Average System Nameplate Capacity

$$C_{avg, j, i} = \sum_k^n \frac{(d_{k, j} * C_{k, j})}{D_i}$$

i = year

j = insulating gas

k = GIE device

m = number of insulating gases

n = number of devices

Revisions to CARB Regulation

Average CO₂eCapacity

$$\text{Average CO}_2 \text{ e capacity} = \sum_j^m \frac{\text{GWP}_j * C_{avg, j, i}}{2204.62}$$

Revisions to CARB Regulation

Baseline CO₂e Capacity 2024

$$BL\ CO_2\ e\ capacity\ (12/31/2024) = \sum_j^m \frac{GWP_j * C_{k,j}}{2204.62}$$

i = year

j = insulating gas

k = GIE device

m = number of insulating gases

n = number of devices

Revisions to CARB Regulation

Baseline CO₂e Capacity 2025+

BL CO₂e capacity $_{12/31/2024, i}$ =

$$\text{BL CO}_2 \text{e capacity}_{12/31/2024, i-1} - \sum_j^m \frac{\text{GWP}_j * C_{knc, j}}{2204.62} + \sum_j^m \frac{\text{GWP}_j * C_{knac, j}}{2204.62}$$

$$- \sum_j^m \frac{\text{GWP}_j * C_{kr, j}}{2204.62} + \sum_j^m \frac{\text{GWP}_j * C_{kn, j}}{2204.62}$$

i = year
 j = insulating gas
 k = GIE device
 m = number of insulating gases
 n = number of devices

Revisions to CARB Regulation

Early Action Credit

$$EAC_i = \sum_k^n C_{e,k} - \sum_l^o C_{er,l} + EAC_{i-1}$$

Voltage Capacity (kV)	MTCO ₂ e
72.5	300
72.5 < x ≤ 145	700
145 < x ≤ 245	1900
≥ 245	2400

l = Devices removed
 0 = number of devices removed

C_{e,k} = GHG capacity from the Table

i = year
 j = insulating gas
 k = GIE device
 m = number of insulating gases
 n = number of devices

Revisions to CARB Regulation

Baseline CO₂e Capacity 2025+ EAC

$$\begin{aligned} \mathbf{BL\ CO_2\ e\ capacity}_i &= \mathbf{EAC}_{\leq 10} + \mathbf{BL\ CO_2\ e\ capacity}_{12/31/2024, i} \\ &+ \mathbf{Average\ BL\ CO_2\ e\ capacity}_i \end{aligned}$$

Revisions to CARB Regulation

Emissions Factors

≥ 10,000 MTCO₂e

Year	AEF
2021 - 2034	1.0
2035+	.95

< 10,000 MTCO₂e

Year	AEF
2021 - 2034	2.0
2035+	1.9

Revisions to CARB Regulation

Annual Emissions Limit

2021 - 2024

$$\text{Emissions Limit}_i = \frac{AEF_i}{100} * (\text{Average } CO_2 \text{ e capacity}_i + EAC_{\leq 10})$$

2025+

$$\text{Emissions Limit}_i = \frac{AEF_i}{100} * BL \text{ } CO_2 \text{ e capacity}_i$$

Revisions to CARB Regulation

§ 95357.2 Nameplate Capacity Adjustment

- Optional
- Only once, unless change in physical capacity
- During maintenance that requires opening gas compartment or removed from service
- Allowed
 - Non-hermetically sealed
 - <38kV
 - Acquired prior to 12/31/2021

Revisions to CARB Regulation

§ 95357.2 Nameplate Capacity Adjustment

- Record initial system pressure and GIE temperature
- Convert system pressure to temp-compensate pressure provided by OEM
- If actual pressure doesn't match intended system pressure, add or remove gas as needed
- Remove all gas from GIE
- Record amount of insulating gas removed
 - Flow meter
 - Weigh cylinders



Other States

Massachusetts Dept. of Environmental Protection

- Reporting requirements first published in 2014; amended in 2017 to include emissions reduction requirements
- Only applies to mandatory federal reporters (Eversource and National Grid)
- 1% leak rate for GIS purchased after Jan 1, 2015
- Reduction goals
 - 1% emission rate limit
 - Emissions mass limit
 - 1,457 – National Grid
 - 2,460 - Eversource

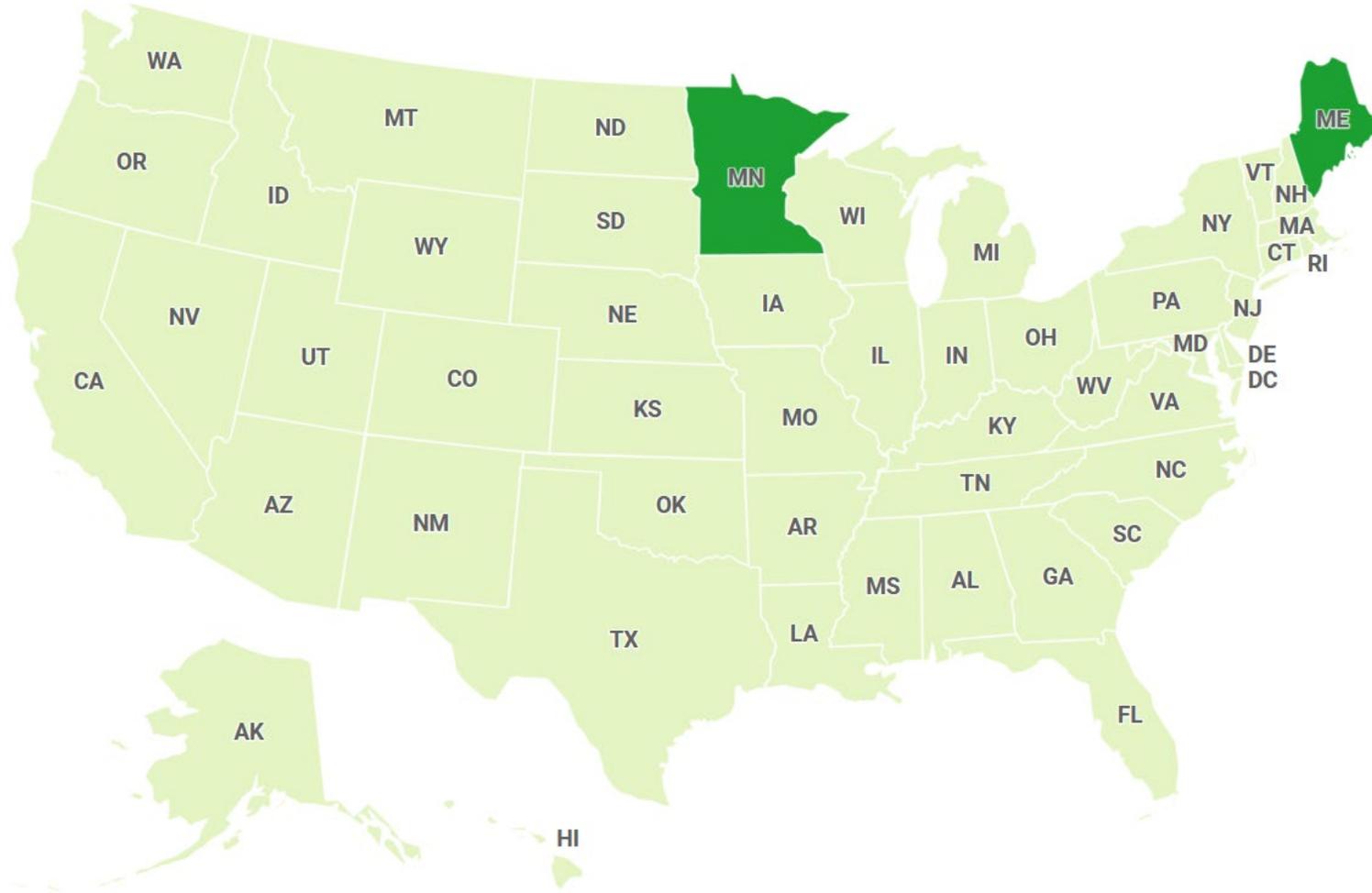
New York State

- New York State Scoping Plan – December 2022
 - Climate Action Council
 - Recommendations to achieve reduction in GHG emissions
- Recommendations specific to the electricity sector: New York Dept of Environmental Conservation should adopt regulations to reduce SF₆ emissions and establish a timeline for phasing out new SF₆ equipment
- NYSEC in pre-proposal phase
- Similar timeline to CA



Per - & Poly - Fluorinated Alkyl Substances (PFAS)

States with PFAS-related Regulations



Per- and Poly- fluorinated Substances (PFAS)

- Group of chemicals used to make fluoropolymer coatings and products that resist heat, oil, stains, grease, and water
- Linked to negative health effects in humans
- C4-Fluoronitrile and C5-Fluoroketone are in the PFAS group
- Used in several alternative gas mixtures

Maine PFAS Law

- Enacted in 2021
- Requires manufacturers of products with intentionally added PFAS to report the intentionally added presence of PFAS in those products to the Department, beginning January 1, 2023.
- Effective January 1, 2030, any product containing intentionally added PFAS may not be sold in Maine unless the use of PFAS in the product is specifically designated as a currently unavoidable use by the State.
- Many industry groups, including NEMA, are weighing in

Minnesota PFAS Law

- Enacted in 2023
- Manufacturers of all products containing intentionally added PFAS would be required to notify the MPCA of their use of PFAS starting January 1, 2026.
 - a description of the product,
 - the purpose of using PFAS in the product,
 - the amount of each type of PFAS in the product (as an exact quantity determined by testing or within a range approved by the MPCA),
 - the contact information of the manufacturer,
 - and any additional information required by the agency
- Starting January 1, 2032, the sale or distribution of any new product containing intentionally added PFAS would be prohibited unless the MPCA has exempted it.



Thank You

